

# Technical Memorandum

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## *Significant Nutrient Nonpoint Sources in the Maryland Coastal Bays Watershed*

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The U.S. Environmental Protection Agency (EPA) requires that Total Maximum Daily Load (TMDL) allocations account for all significant sources of the impairing pollutant or pollutants (CFR 2013). The TMDL analysis for the Maryland Coastal Bays sets total nitrogen (TN) and total phosphorus (TP) loading caps for both growing season (May-October) and average annual conditions. This technical memorandum identifies, in detail, the nonpoint source discharges of TN and TP in the Maryland Coastal Bays watershed and assigns allocations to the different land uses and source sectors that are included in the TMDL Load Allocations (LAs). The upstream LAs are aggregate LAs that are intended to be subdivided at the discretion of the applicable jurisdictions. Therefore, they are not included in this technical memorandum. This document presents one means of allocating the nonpoint source loads among the various land-use categories and source sectors in the Maryland Portion of the Coastal Bays watershed, within the loading limits set forth in the TMDL LAs. These are conceptual values that are designed to meet the TMDL thresholds. The State expressly reserves the right to allocate the TMDLs among different sources in any manner that is reasonably calculated to achieve water quality standards.

The estimated nonpoint source loads simulated in the Coastal Bays watershed model account for all natural and human-induced sources. The growing season nonpoint source loads and the average annual nonpoint source loads were both estimated using the Hydrological Simulation Program FORTRAN (HSPF) watershed model. As explained in the main TMDL report, the simulation of the Coastal Bays watershed used the following assumptions: (1) the variability in patterns of precipitation were estimated from existing National Oceanic and Atmospheric Administration (NOAA) meteorological stations; (2) the hydrologic response of land areas were estimated for a simplified set of land uses in the basin; and (3) agricultural information was estimated using 2002 Delaware Land Use and Land Cover (Delaware Spatial Data Implementation Team 2003), the Worcester County Land Use Database, the U.S. Geological Survey's (USGS) National Land Cover Database for Virginia (USGS 1999), and the 2002 Agricultural Census. The modeled nonpoint source nutrient loads account for contributions from atmospheric deposition (both indirectly to the watershed and directly to the surface of the tidal waters), septic systems, cropland, pasture, feedlots, urban areas, and forest. National Pollutant Discharge Elimination System (NPDES) regulated urban stormwater loads from Municipal Separate Storm Sewer Systems (MS4s), industrial stormwater facilities, etc. are considered point sources by EPA, and therefore they need to be included as part of the Wasteload Allocation (WLA) portion of a TMDL. However, there are no NPDES regulated stormwater permits in the Maryland Coastal Bays watershed. Thus, the urban stormwater nitrogen and phosphorus loadings in the watershed are included within the LA portion of the TMDL, and they are presented here in the Nonpoint Source Technical Memorandum. Concentrated Animal Feeding Operations (CAFOs) are regulated under NPDES permits. Therefore, they are included in the point source technical memorandum, *Significant Nutrient Point Sources in the Maryland Coastal Bays Watershed*.

The nutrient load reductions applied to nonpoint sources in the TMDL analysis are designed to protect water quality endpoints for dissolved oxygen (DO) and chlorophyll in the Maryland Coastal

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Bays. For details on how load reductions were established for each nonpoint source sector, please refer to the main document and the document, “The Hydrodynamic/Water Quality Modeling and TMDL Development for Maryland’s Coastal Bay System” (Wang 2013). Tables 1 and 2 present one possible scenario for the distribution of the growing season nitrogen and phosphorus nonpoint source LAs among the various land use categories and source sectors. Tables 3 and 4 present one possible scenario for the distribution of the average annual nitrogen and phosphorus nonpoint source LAs among the various land use categories and source sectors. These loading distributions are based on the percentages of each particular land use/source sector relative to the total area of that land use/source sector in the watershed.

**Table 1: Nonpoint Source Nitrogen LAs - Growing Season (May 1<sup>st</sup> - October 31<sup>st</sup>)**

Basin Name	Urban		Mixed Agriculture (Excluding CAFOs)		Forest		Septic		Atmospheric Deposition <sup>1</sup>		Shoreline Erosion	
	% of NPS <sup>3</sup> Load	lbs/growing season <sup>4</sup>	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season
Greys Creek	14	2,386	40	6,894	4	702	14	2,306	13	2,255	15	2,499
<b>Assawoman Bay<sup>2</sup></b>	<b>21</b>	<b>9,813</b>	<b>15</b>	<b>7,066</b>	<b>2</b>	<b>1,071</b>	<b>5</b>	<b>2,341</b>	<b>45</b>	<b>21,305</b>	<b>12</b>	<b>5,462</b>
Bishopville Prong	23	2,768	43	5,234	6	781	17	2,092	6	744	4	452
Shingle Landing Prong	29	5,579	47	9,242	9	1,704	10	1,924	2	438	3	665
St. Martin River <sup>2</sup>	26	12,174	36	16,663	6	2,808	12	5,530	14	6,306	6	3,014
Herring Creek	37	2,652	15	1,115	9	663	11	784	7	482	21	1,555
Turville Creek	32	3,986	20	2,493	6	749	22	2,779	4	525	17	2,092
Manklin Creek	54	4,083	6	440	5	362	5	405	13	963	17	1,287
<b>Isle of Wight Bay<sup>2</sup></b>	<b>29</b>	<b>28,330</b>	<b>21</b>	<b>20,712</b>	<b>5</b>	<b>4,712</b>	<b>10</b>	<b>9,515</b>	<b>25</b>	<b>24,566</b>	<b>10</b>	<b>9,365</b>
Ayer Creek/Kitts Branch	39	12,098	35	11,091	5	1,661	13	4,144	7	2,311	0	0
Newport Creek	22	1,956	50	4,444	7	645	16	1,440	5	437	0	0
Marshall Creek	29	4,083	41	5,869	7	1,032	7	1,036	12	1,686	4	595
<b>Newport Bay<sup>2</sup></b>	<b>27</b>	<b>21,910</b>	<b>35</b>	<b>27,855</b>	<b>5</b>	<b>4,247</b>	<b>11</b>	<b>8,473</b>	<b>18</b>	<b>14,301</b>	<b>4</b>	<b>3,111</b>
<b>Sinepuxent Bay</b>	<b>26</b>	<b>11,468</b>	<b>6</b>	<b>2,413</b>	<b>3</b>	<b>1,144</b>	<b>8</b>	<b>3,485</b>	<b>47</b>	<b>20,540</b>	<b>10</b>	<b>4,532</b>
<b>Chincoteague Bay</b>	<b>3</b>	<b>7,648</b>	<b>21</b>	<b>53,565</b>	<b>3</b>	<b>7,064</b>	<b>2</b>	<b>5,240</b>	<b>61</b>	<b>158,150</b>	<b>10</b>	<b>26,959</b>

<sup>1</sup> Atmospheric deposition to land surfaces is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban. The load attributed to atmospheric deposition in this table represents the loading to the surface of the tidal waters only.

<sup>2</sup> This allocation includes the allocations from for the applicable sub-basins.

<sup>3</sup> NPS: nonpoint source

<sup>4</sup> lbs: pounds

**Table 2: Nonpoint Source Phosphorus LAs - Growing Season (May 1<sup>st</sup> - October 31<sup>st</sup>)**

Basin Name	Urban		Mixed Agriculture (Excluding CAFOs)		Forest		Septic		Atmospheric Deposition <sup>1</sup>		Shoreline Erosion	
	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season	% of NPS Load	lbs/growing season
Greys Creek	21	252	47	575	4	46	0	0	10	119	19	231
<b>Assawoman Bay<sup>2</sup></b>	<b>30</b>	<b>990</b>	<b>18</b>	<b>590</b>	<b>2</b>	<b>70</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>1,127</b>	<b>15</b>	<b>504</b>
Bishopville Prong	15	186	71	871	4	51	0	0	3	39	7	84
Shingle Landing Prong	19	369	69	1,359	6	112	0	0	1	23	5	106
St. Martin River <sup>2</sup>	21	898	57	2,430	4	185	0	0	8	333	9	393
Herring Creek	41	238	18	107	7	44	0	0	4	25	29	173
Turville Creek	39	350	26	234	6	49	0	0	3	28	26	232
Manklin Creek	60	388	6	39	4	24	0	0	8	51	22	143
<b>Isle of Wight Bay<sup>2</sup></b>	<b>30</b>	<b>2,354</b>	<b>36</b>	<b>2,810</b>	<b>4</b>	<b>310</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>1,299</b>	<b>14</b>	<b>1,098</b>
Ayer Creek/Kitts Branch	53	1,242	37	862	5	109	0	0	5	122	0	0
Newport Creek	34	206	56	341	7	42	0	0	4	23	0	0
Marshall Creek	18	153	54	450	8	68	0	0	11	89	9	80
<b>Newport Bay<sup>2</sup></b>	<b>36</b>	<b>1,997</b>	<b>38</b>	<b>2,145</b>	<b>5</b>	<b>279</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>756</b>	<b>7</b>	<b>417</b>
<b>Sinepuxent Bay</b>	<b>36</b>	<b>1,180</b>	<b>6</b>	<b>188</b>	<b>2</b>	<b>75</b>	<b>0</b>	<b>0</b>	<b>33</b>	<b>1,086</b>	<b>23</b>	<b>735</b>
<b>Chincoteague Bay</b>	<b>5</b>	<b>827</b>	<b>22</b>	<b>3,808</b>	<b>3</b>	<b>479</b>	<b>0</b>	<b>0</b>	<b>49</b>	<b>8,363</b>	<b>22</b>	<b>3,715</b>

<sup>1</sup> Atmospheric deposition to land surfaces is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban. The load attributed to atmospheric deposition in this table represents the loading to the surface of the tidal waters only.

<sup>2</sup> This allocation includes the allocations for the applicable sub-basins.

**Table 3: Nonpoint Source Nitrogen LAs - Average Annual**

Basin Name	Urban		Mixed Agriculture (Excluding CAFOs)		Forest		Septic		Atmospheric Deposition <sup>1</sup>		Shoreline Erosion	
	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year
Greys Creek	13	4,553	45	15,935	3	1,086	13	4,611	13	4,511	14	4,997
<b>Assawoman Bay<sup>2</sup></b>	<b>20</b>	<b>18,706</b>	<b>17</b>	<b>16,341</b>	<b>2</b>	<b>1,657</b>	<b>5</b>	<b>4,682</b>	<b>45</b>	<b>42,611</b>	<b>12</b>	<b>10,923</b>
Bishopville Prong	21	5,280	49	12,632	5	1,209	16	4,183	6	1,489	4	904
Shingle Landing Prong	25	10,641	54	22,703	6	2,488	9	3,848	2	876	3	1,329
St. Martin River <sup>2</sup>	24	23,214	42	40,761	4	4,169	11	11,059	13	12,612	6	6,028
Herring Creek	35	5,052	19	2,751	7	968	11	1,569	7	963	22	3,110
Turville Creek	30	7,599	24	6,077	4	1,094	22	5,558	4	1,051	16	4,185
Manklin Creek	53	7,776	7	1,075	4	529	6	810	13	1,927	18	2,575
<b>Isle of Wight Bay<sup>2</sup></b>	<b>27</b>	<b>53,975</b>	<b>26</b>	<b>50,666</b>	<b>4</b>	<b>6,951</b>	<b>10</b>	<b>19,030</b>	<b>25</b>	<b>49,132</b>	<b>9</b>	<b>18,730</b>
Ayer Creek/Kitts Branch	35	23,071	42	27,512	4	2,427	13	8,288	7	4,621	0	0
Newport Creek	19	3,731	57	11,160	5	942	15	2,879	4	874	0	0
Marshall Creek	11	2,966	57	14,761	6	1,507	8	2,072	13	3,372	5	1,189
<b>Newport Bay<sup>2</sup></b>	<b>22</b>	<b>36,966</b>	<b>42</b>	<b>69,432</b>	<b>4</b>	<b>6,204</b>	<b>10</b>	<b>16,945</b>	<b>17</b>	<b>28,601</b>	<b>4</b>	<b>6,221</b>
Sinepuxent Bay	25	21,869	7	5,951	2	1,671	8	6,971	47	41,080	10	9,064
Chincoteague Bay	3	14,448	23	122,594	2	10,916	2	10,479	60	316,300	10	53,918

<sup>1</sup> Atmospheric deposition to land surfaces is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban. The load attributed to atmospheric deposition in this table represents the loading to the surface of the tidal waters only.

<sup>2</sup> This allocation includes the allocations for the applicable sub-basins.

**Table 4: Nonpoint Source Phosphorus LAs - Average Annual**

Basin Name	Urban		Mixed Agriculture (Excluding CAFOs)		Forest		Septic		Atmospheric Deposition <sup>1</sup>		Shoreline Erosion	
	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year	% of NPS Load	lbs/year
Greys Creek	19	468	48	1,162	4	86	0	0	10	239	19	461
<b>Assawoman Bay<sup>2</sup></b>	<b>29</b>	<b>1,843</b>	<b>19</b>	<b>1,191</b>	<b>2</b>	<b>131</b>	<b>0</b>	<b>0</b>	<b>35</b>	<b>2,254</b>	<b>16</b>	<b>1,008</b>
Bishopville Prong	14	344	72	1,796	4	95	0	0	3	79	7	167
Shingle Landing Prong	17	686	71	2,831	5	212	0	0	1	46	5	212
St. Martin River <sup>2</sup>	20	1,669	59	5,045	4	347	0	0	8	667	9	786
Herring Creek	39	444	19	223	7	83	0	0	4	51	30	345
Turville Creek	37	651	28	487	5	93	0	0	3	56	27	465
Manklin Creek	58	725	7	82	4	45	0	0	8	102	23	286
<b>Isle of Wight Bay<sup>2</sup></b>	<b>28</b>	<b>4,396</b>	<b>37</b>	<b>5,837</b>	<b>4</b>	<b>584</b>	<b>0</b>	<b>0</b>	<b>17</b>	<b>2,599</b>	<b>14</b>	<b>2,197</b>
Ayer Creek/Kitts Branch	51	2,309	39	1,800	5	207	0	0	5	244	0	0
Newport Creek	31	382	58	715	7	80	0	0	4	46	0	0
Marshall Creek	17	286	56	942	8	129	0	0	11	178	9	159
<b>Newport Bay<sup>2</sup></b>	<b>34</b>	<b>3,711</b>	<b>41</b>	<b>4,486</b>	<b>5</b>	<b>529</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>1,512</b>	<b>8</b>	<b>833</b>
<b>Sinepuxent Bay</b>	<b>34</b>	<b>2,193</b>	<b>6</b>	<b>393</b>	<b>2</b>	<b>143</b>	<b>0</b>	<b>0</b>	<b>34</b>	<b>2,172</b>	<b>23</b>	<b>1,469</b>
<b>Chincoteague Bay</b>	<b>4</b>	<b>1,506</b>	<b>22</b>	<b>7,616</b>	<b>3</b>	<b>882</b>	<b>0</b>	<b>0</b>	<b>49</b>	<b>16,726</b>	<b>22</b>	<b>7,429</b>

<sup>1</sup> Atmospheric deposition to land surfaces is included in the loads attributed to mixed agriculture, forest and other herbaceous, and urban. The load attributed to atmospheric deposition in this table represents the loading to the surface of the tidal waters only.

<sup>2</sup> This allocation includes the allocations for the applicable sub-basins.

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